

## CLAIMS

I Claim:

~~Claim 1 - A loss on drying apparatus, comprising in combination~~  
a microwave chamber;

a microwave energy source operatively coupled to said chamber for delivering microwave energy thereto for drying a sample therein;

at least one microwave energy sensor operatively disposed within said microwave chamber.

Claim 2 - The apparatus of claim 1 further including weighing means operatively disposed within said microwave chamber.

Claim 3 - The apparatus of claim 2 wherein said weighing means is used before a drying process to determine an initial weight of the sample.

Claim 4 - The apparatus of claim 3 wherein said energy sensor monitors microwave energy within said microwave chamber for controlling said drying process of the sample contained within said microwave chamber.

Claim 5- The apparatus of claim 4 wherein said weighing means is used after said drying process to determine a final weight of the sample.

Claim 6- The apparatus of claim 5 further including means for determining a percentage of moisture or volatiles in the sample.

Claim 7- The apparatus of claim 6 wherein said percentage of moisture or volatiles in the sample is determined by the formula:

$$\%M = ((W_I - W_F)/W_I)(100)$$

where

%M is said percentage of moisture in the sample,

W<sub>I</sub> is said initial weight of the sample, and

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W<sub>F</sub> is said final weight of the sample.

Claim 8 - The apparatus of claim 1 wherein said energy sensor is operatively coupled to said microwave energy source for controlling the delivery of microwave energy to said microwave chamber correlative to energy sensed by said sensor thereby controlling a drying process of said sample.

Claim 9 - The apparatus of claim 8 wherein said energy sensor monitors microwave energy within said microwave chamber for determining when said drying process of the sample is complete.

Claim 10 - The apparatus of claim 9 wherein said energy sensor is operatively coupled to said microwave energy source for turning said microwave energy source off when said energy sensor determines that said drying process of the sample is complete.

Claim 11 - The apparatus of claim 1 wherein said microwave chamber is cylindrical in shape.

Claim 12 - The apparatus of claim 11 including tuning rods disposed in said cylindrical microwave chamber.

Claim 13 - The apparatus of claim 12 including first and second magnetic modes of microwave energy within said cylindrical microwave chamber, said first and second magnetic modes of microwave energy oriented transverse with respect to one another.

Claim 14 - The apparatus of claim 13 including means for loading a sample from a top of said microwave chamber.

Claim 15 - The apparatus of claim 14 including an attenuating stub in a microwave waveguide coupling said microwave energy source to said microwave chamber.

Claim 16 - The apparatus of claim 15 including glass pads located in said microwave chamber to receive a sample to be dried.

Claim 17 - The apparatus of claim 1 wherein said energy sensor senses microwave energy previously allocated to drying the sample.

Claim 18 - The apparatus of claim 1 wherein said energy sensor is operatively coupled to said microwave energy source for turning said microwave energy source off when said energy sensor detects a predetermined energy level within said microwave chamber.

Claim 19- The apparatus of claim 1 wherein said energy sensor is operatively coupled to said microwave energy source for turning said microwave energy source off when at least one said energy sensor detects an energy increase level having a slope which is less than a certain predetermined slope of an energy curve.

Claim 20 - A method for loss on drying, the steps including:

- placing a specimen in a cylindrical microwave;
- monitoring the microwave energy within the cylindrical microwave while powering the microwave to dry the specimen;
- venting moisture from the microwave during a drying process.

Claim 21 - The method of claim 20 further including the step of subsequently decreasing the microwave power during drying process.

Claim 22 - A microwave moisture analyzer, comprising in combination:

- a cylindrical microwave containment chamber;
- said cylindrical microwave containment chamber including a pair of portals disposed therein;
- a microwave energy source;

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a wave guide operatively coupled between said microwave energy source and said portals for delivering microwave energy to said chamber;

means for supporting a sample within said chamber;

means for sensing microwave energy for controlling the amount of microwave energy delivered to said chamber as a function of the sample being analyzed.

Claim 23 - The microwave moisture analyzer of claim 22 further including a toploading electronic balance operatively disposed within said microwave chamber.

Claim 24 - The microwave moisture analyzer of claim 23 wherein said electronic balance is only actuated prior to and after the delivery of microwave energy to said chamber for determining an initial weight and a final weight of the sample.

Claim 25 - The microwave moisture analyzer of claim 24 further including means operatively coupled to said electronic balance for automatically determining sample moisture.

Claim 26 - A method for loss on drying, the steps including:

placing a specimen in a cylindrical microwave;

delivering microwave energy to the cylindrical microwave;

monitoring the microwave energy within the cylindrical microwave;

controlling a drying process of the specimen as a function of the monitored microwave energy.

Claim 27 - The method of claim 26 further including the step of venting moisture from the microwave continuously during the drying process.

Claim 28 - The method of claim 27 wherein the step of delivering microwave energy includes delivering first and second magnetic modes of microwave energy, one oriented transverse with respect to the other.

Claim 29 - The method of claim 28 including the step of providing a first and a second tuning rod within the cylindrical microwave to promote a resonance condition and stirring of the microwave energy within the cylindrical microwave.

Claim 30 - The method of claim 29 wherein monitoring the microwave energy includes sensing microwave energy previously allocated to drying the sample wherein the sensed microwave energy is correlative to the energy unabsorbed by the sample.

Claim 31 - The method of claim 30 further including the step of surceasing the delivery of microwave energy to the cylindrical microwave when at least one said energy sensor detects an energy increase level of less than a certain predetermined slope.

Claim 32 - A method for loss on drying, the steps including:

- placing a sample in a chamber;
- weighing the sample to obtain an initial weight thereof;
- applying microwave energy to a chamber containing the sample;
- sensing the microwave energy within the chamber for controlling a drying process of the sample to a endpoint by modifying the amount of applied microwave energy;
- reweighing the sample at an end of the drying process to obtain a final weight thereof.

Claim 33 - The method of claim 32 further including the step of determining a moisture content of the sample from the initial and final weights.

Claim 34 - A method for loss on drying, the steps including:

applying microwave energy to a sample having a known weight;  
monitoring the microwave energy;  
surceasing the applied microwave energy as a function of the monitored microwave energy.

Claim 35 - The method of claim 34 wherein the step of surceasing the microwave energy occurs when the monitored microwave energy has a signature correlative to a stabilized high value.

Claim 36 - The method of claim 35 further including the step of obtaining the final weight of the sample.

Claim 37 - The method of claim 36 further including the step of determining a moisture content of the sample as a function of the initial and final weights.

Claim 38 - A method for loss on drying, the steps including:

applying microwave energy to a sample having a known weight and contained with in a chamber;

sensing the energy within the chamber and outputting a signal correlative to the sensed energy;

comparing the outputted signal to a predetermined signal level;

regulating the applied microwave energy as a function of the comparison step for drying the sample.

Claim 39 - The method of claim 38 further including the step of measuring a first interval of time between an initial application of microwave energy and when an outputted signal correlative to the sensed energy is at a first predetermined signal level.

Claim 40 - The method of claim 39 wherein the step of regulating the applied microwave energy includes ramping down the applied energy to a ratio of the first predetermined signal level.

Claim 41 - The method of claim 40 wherein the applied energy is ramped down over an interval of time substantially equal to the measured first interval of time.

Claim 42 - The method of claim 39 wherein the step of regulating the applied microwave energy includes ramping down the applied energy to a ratio of the first predetermined signal level over an interval which is a multiple of the measured first interval of time.

Claim 43 - The method of claim 39 wherein the step of regulating the applied microwave energy includes ramping down the applied energy to subsequently decreasing ratios of the first predetermined signal level over subsequent intervals of time which are each a multiple of the first interval of time.

Claim 44 - A method for loss on drying, the steps including:

- establishing an algorithm correlative to a change in radiation as function of load absorbability;
- sensing radiation correlative to an absorbability of a load being radiated within a chamber;
- comparing the sensed radiation to the algorithm for determining a benchmark correlative to an endpoint condition.

Claim 45 - The method of claim 44 further including the step of determining an initial weight of the load before being radiated.

Claim 46 - The method of claim 45 further including the step of determining a final weight of the load after the endpoint condition.

Claim 47 - he method of claim 46 further including the step of determining moisture content of the load.

Claim 48 - A method for loss on drying, the steps including:

establishing a characteristic radiation curve of a sample type correlative of its radiation absorbability;

radiating a specimen of the sample type;

developing a specimen radiation curve by monitoring a change in radiation correlative to radiation absorbability of the specimen;

comparing a transition of slope on the characteristic radiation curve with a transition of slope on the specimen radiation curve;

continuing to radiate the specimen until a predetermined endpoint condition has been met based on the comparison step.

Claim 49 - A method for loss on drying, the steps including:

establishing a benchmark correlative to a level of microwave energy sensed by a sensor;

employing the sensor to monitor a level of microwave energy within a chamber wherein a sample is being radiated;

comparing the monitored energy level with the benchmark level for controlling a drying process of the sample.

Claim 50 - A method for loss on drying, the steps including:

establishing a characteristic radiation curve of a sample type correlative of its radiation absorbability;

radiating a sample contained within a chamber;

comparing subsequently sensed levels of radiation within the chamber with the characteristic curve for determining an endpoint condition.



Claim 51 - The apparatus of claim 1 further including means for detecting radiant energy within said microwave chamber.

Claim 52 - The apparatus of claim 51 wherein said means for detecting radiant energy includes means for detecting radiant energy in the form of light.

Claim 53 - The apparatus of claim 1 further including means for a gaseous product within said microwave chamber.

Claim 54 - The method of claim 20 wherein the monitoring step includes monitoring electric field strengths within the cylindrical microwave while powering the microwave to dry the specimen.

Claim 55- The method of claim 20 wherein the monitoring step includes monitoring magnetic field strengths within the cylindrical microwave while powering the microwave to dry the specimen.

Claim 56 - A loss on drying apparatus, comprising in combination:

a microwave chamber;

a microwave energy source operatively coupled to said chamber for delivering microwave energy thereto for drying a sample therein;

at least one microwave energy sensor operatively disposed within said microwave chamber for sensing the microwave energy, and

means for rotating the sample within the microwave chamber during drying.

Claim 57 - A method for loss on drying, the steps including:

placing a sample in a microwave;

delivering microwave energy to the microwave;

monitoring the microwave energy within the microwave;

rotating the sample within the microwave, and

~~controlling a drying process of the sample as a function of the  
monitored microwave energy.~~

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